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Repeat Photography in the Marshall Brook Watershed

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IQP:
Repeat Photography in the Marshall Brook Watershed

An Interactive Qualifying Project submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science

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Abstract

Watersheds, as defined by the United States Geological Survey, are areas of land where precipitation collects and drains out through a common outlet. The ecological stability of these natural drainage systems are extremely delicate and easily disrupted, especially when exposed to human influence. Within Acadia National Park, it was found that the Marshall Brook Watershed is undergoing changes hazardous to Acadia's ecological health. To aid in the identification of these problems, specific locations were documented using common photographic techniques to establish a baseline for future repeat photography in the area. Data gathered from repeat photography studies can then aid future conservation efforts the Park will conduct in the Marshall Brook Watershed.

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Our team would like to thank all of those who helped to make our project a reality. We could not have completed this without the help of the following people:

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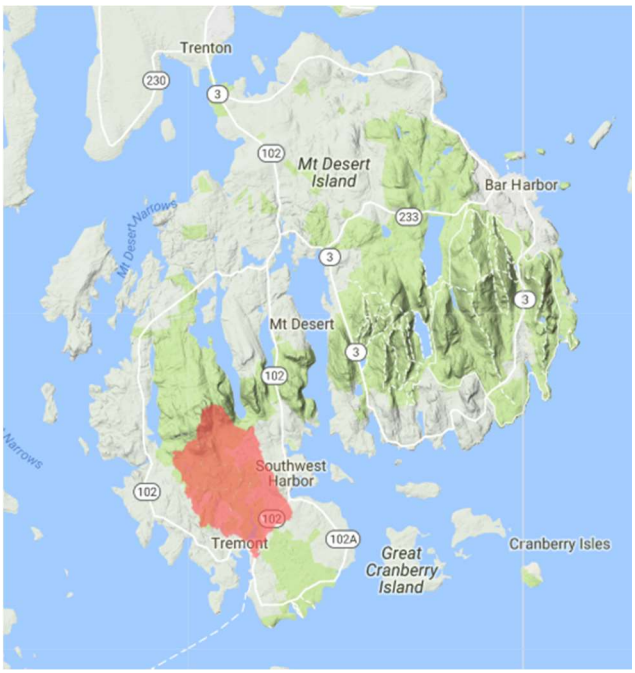
Executive Summary

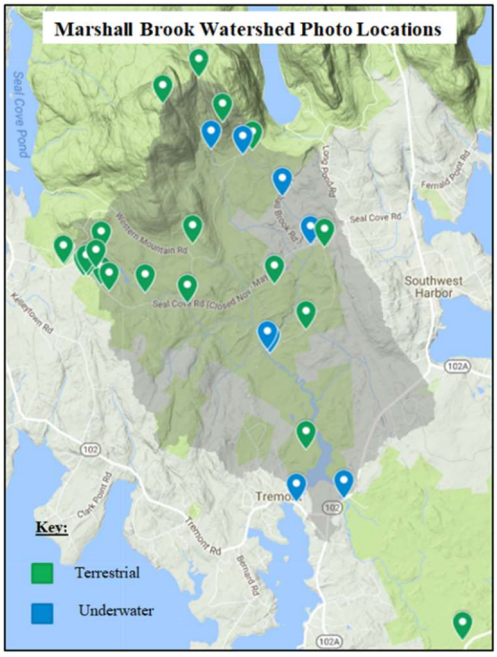
Acadia National Park is unique compared to other national parks because of its relatively small size yet a large number of visitors. Therefore, the park is more susceptible to human impact from pollution, construction and other means. The launching of the *Wild Acadia Initiative* in 2014 aimed to better control and understand the changes in the park. The Marshall Brook Watershed was chosen as an area of concern due to its significant role in the hydrology on the western side of Mount Desert Island. The goal of this project was to create a repeat photography methodology that could be used to monitor sites of possible degradation for extended periods of time as well as create a baseline with which to monitor conservation efforts in the Marshall Brook Watershed.



The Marshall Brook Watershed, shown in red, is located on the Southwest side of Mount Desert Island.

From June 21st to 22nd, five sites that had been photographed by the 2015 Cromwell Brook Watershed team were visited and had their photographs repeated. The collection of data gathered from these sites was used to evaluate the value of repeat photography to the *Wild Acadia Initiative* and improve upon the methodology used by the Cromwell Brook Watershed team. The team decided to increase the number of data points collected at each site in order to ease repeatability.

From June 25th to July 18th, a total of 30 sites were visited and documented by the team. The initial list of sites was given to us by staff at Acadia National Park. Additional sites were documented at the team's discretion when out in the field. Additionally, underwater photographs were taken at 8 select sites to monitor current water clarity. Several changes to the Cromwell Brook Watershed team's methodology had been implemented such as upgrading the camera, inserting a grade rod as a size reference into each photo and increasing the number of data points collected at each photo point from 15 to 22.



From July 18th to July 20th, four photo points were revisited by the team to test the repeatability of the established methodology and data collected. These repeated photographs came out as almost identical replicas of the team's original photographs from these points, therefore proving the benefit and success of the improved methodology. After this experiment was conducted, a field guide, aimed to help those in the future prepare to repeat photographs, was developed.

The only significant differences present in theses repeated photos were in lighting and plant growth.

The establishment of this methodology for repeat photography will be vital to the Parks conservation efforts in not only the Marshall Brook Watershed but throughout the Acadia National Park. This project has created a powerful way to document and monitor areas of the park in order to track change and prevent ecological problems before they arise.

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Appendix: Alicea Hyland, Katharine Conroy, Joe Montuoro, Isaac Patry

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Chapter 1: Introduction

On December 20th, 2016 the National Park Service (NPS) issued Director's Order #100 "Resource Stewardship for the 20th Century." (Miller-Rushing, Henkel, Cole-Will, 2017) This order changed the focus of the NPS from "maintaining parks as 'vignettes of primitive America'" to managing parks with the understanding that some change is uncontrollable and not fully understood. (Miller-Rushing, Henkel, Cole-Will, 2017) Ultimately the purpose of this new directive is to maintain the health of ecosystems within America's National Parks. In response to this new directive, Acadia National Park began the *Wild Acadia* initiative. The purpose of *Wild Acadia* is fundamentally the same as Director's Order #100, "to preserve and restore" the natural resources within Acadia. (Miller-Rushing, Henkel, Cole-Will, 2017)

A large ecological impact is made by the over two million visitors that come to Acadia National Park each year. (NPS, 2015) Therefore, in order to meet the goals of the *Wild Acadia* initiative, *The Friends of Acadia*, a privately funded organization that aids Acadia National Park in its preservation, has dedicated its resources and time to identify areas of environmental concern within the Park. Such areas include the Park's watersheds, which are essential to the stability and ecological health of Acadia as they are vital to the flow and cleanliness of water in the Park. Therefore, Acadia National Park has dedicated the past three years to identifying and correcting the problems of impeded water flow affecting the ecology of the Cromwell Brook Watershed. Since the completion of work in this area, Acadia has shifted its focus onto the Marshall Brook Watershed. This project will, therefore, help *The Friends of Acadia* to create a current ecological baseline that will allow them to determine the effectiveness of their corrections in the future.

Preliminary data has shown that problems common to watersheds have been discovered in the Marshall Brook area. Such problems include the risk of flooding and erosion, which have the potential to compromise the health of the watershed. Prior to this project little work had been done to address these issues, therefore the baseline created here will help jumpstart the study of Marshall Brook by providing large amounts of data and creating an established methodology for future studies.

The main goal of the Marshall Brook Watershed project was to establish a baseline that would serve to support future repeat photography in the Marshall Brook Watershed area. In order to develop a suitable method to carry out this goal, an in-field review of the effectiveness of the 2015 Cromwell Group was conducted. In addition to the use of terrestrial photography, this project also explored the use of underwater photography with the goal of building a more thorough baseline for future researchers to utilize.

Chapter 2: Background

Section 2.1 Watersheds

A watershed, according to the National Oceanic and Atmospheric Administration (NOAA) (2017), is "a land area that channels rainfall and snowmelt to creeks, streams, and rivers, and eventually to outflow points such as reservoirs, bays, and the ocean." Also referred to as drainage basins or catchments, these regions come in a range of sizes, from local brooks to large networks of streams and rivers all flowing to one location as pictured in Figure 1. (NOAA, 2017)

Figure 1: *A diagram showing the flow of water through a simple watershed*

(See enlarged version in appendix, A1)

Typically the borders of a watershed are defined by the geography of the area. For example, the Mississippi Watershed extends from the Mississippi River out to the peaks of the Appalachian Mountains in the east and the Rocky Mountains in the west. On a smaller scale, any stream collecting rain from a small hillside could be considered a watershed. Simply put, the boundaries of a watershed are dependent on the geological features most relevant to the area in question. (NOAA, 2017)

Outside of the aesthetic value humans hold for bodies of water, they also serve as communal sources of drinking water for all plants, animals, and people. Since water is an

essential resource for all living things, the fact that watersheds distribute water across the land makes the health of watersheds essential. If watersheds are not kept healthy the water flowing through them will carry the damage downstream to ecosystems both within and outside of the watershed. (Friends of Acadia, 2013) Pollutants picked up by rainfall at the top of a mountain are carried into rivers and lakes potentially doing harm to both the aquatic populations within the water and the host of land animals and people that use the water for drinking. Additionally, mass development of land introduces a watershed to non-permeable surfaces, like roads and sidewalks, which allow large volumes of water to flow through drainage channels much faster than normal. With so much water flowing through at once, rivers and streams can easily break their banks resulting in habitat destruction via flooding, erosion, and sedimentation. (NOAA, 2017)

Section 2.2 Wild Acadia and the Marshall Brook Watershed

In Acadia National Park's mission to preserve the natural beauty of Mount Desert Island, they have identified several of the island's watersheds as areas of ecological concern. (Miller-Rushing, Henkal, Cole-Will, 2017) With the beginning of the *Wild Acadia* project in 2014, the Park identified the Cromwell Brook Watershed to be the most immediately concerning region due to its popularity as a part of the Park and the efforts made to make it more accessible to visitors. (Amato, Googins, Kessler, Morrison, 2015) Since then, work to improve Cromwell Brook's overall health has been overwhelmingly successful. As a result, Acadia National Park has now chosen to direct similar efforts toward another area of concern, the Marshall Brook Watershed. (Miller-Rushing, Henkal, Cole-Will, 2017)

The Marshall Brook Watershed lies on the southwestern side of Mount Desert Island, encompassing parts of Acadia National Park as well as a small portion of privately developed land. Beginning within Acadia, rainwater drains down from the peak of Mansell Mountain, through a mix of Park and private lands, into Bass Harbor Marsh, and finally through Bass Harbor into the ocean. (Miller-Rushing, Henkal, Cole-Will, 2017) As was the case in the Cromwell Brook Watershed, the Park had been most concerned with the damaging effects of human activity within the Marshall Brook area. Such activity degrades a watershed's overall health if not properly managed. Similarly to how an unhealthy lifestyle and stress degrades the human immune system, prolonged exposure to environmental stressors leave watersheds and

their associated ecosystems vulnerable to devastating events such as unusually high temperatures, sudden strong storms, and the arrival of non-native species. (Friends of Acadia, 2013) By thoroughly photographing the Marshall Brook Watershed and establishing an ecological baseline of the area's current condition, this project provided the Park with a database that will aid repeat photography studies in the years to come. Through these studies, Acadia National Park can begin to understand what is negatively impacting the watershed and then build an effort to counteract those effects in order to preserve the beauty of another portion of Mount

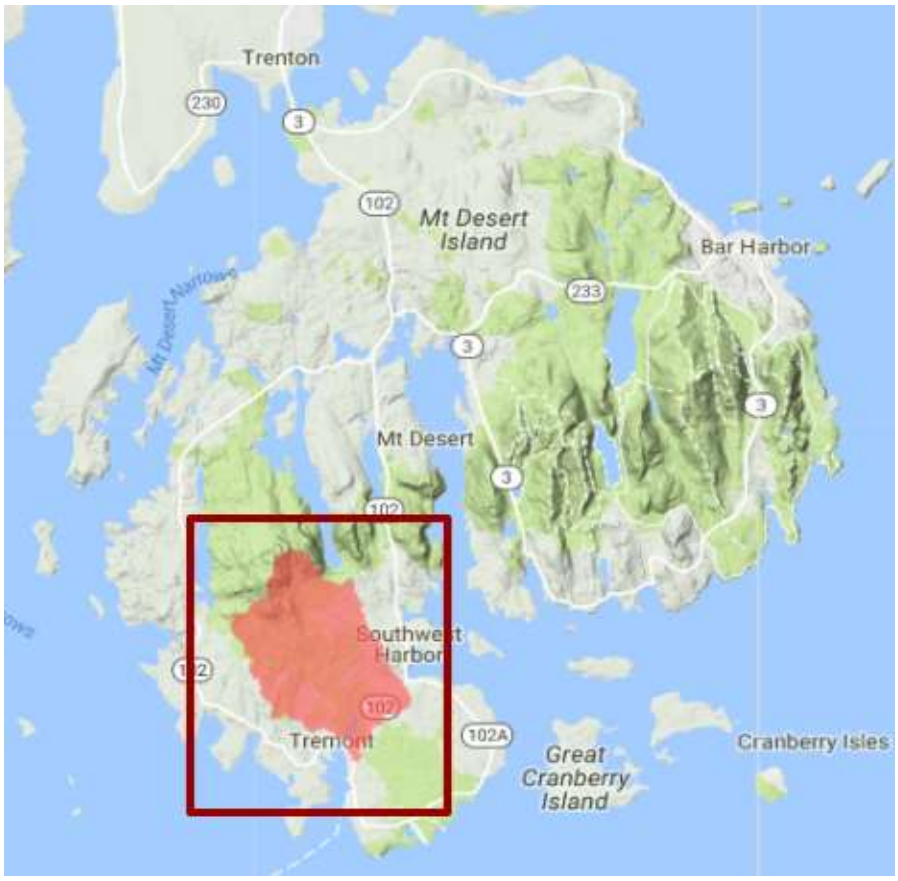


Figure 2: *Map of Mount Desert Island featuring the Marshall Brook Watershed*

Desert Island.

Section 2.3 Establishing an Ecological Baseline

Establishing an ecological baseline is important because human intervention causes dramatic and irreparable changes to the landscape. (Hudson, 2014) Therefore, conservation

efforts and methods, such as establishing ecological baselines, are initiated to observe the effects of humans on nature over time.

As stated in *Past Imperfect: Using Historical Ecology and Baseline Data for Conservation and Restoration Projects in North America* (2012) conservation is often used "to return to that past or recapture some aspect of it… and practitioners regularly invoke images of historical abundance and subsequent decline in their pleas to preserve what is left of wild nature." (Sandlos, Wiersma, Alagonda, 2012) This project was done in order to conserve Acadia National Park's natural beauty and the preservation of the Marshall Brook Watershed due to the fact that it is important to the ecosystem of the area. There are very few places not influenced by human activity, so it is very important to document the effects humans have to prevent any further damage.

In order to preserve Acadia National Park, the Park has begun thoroughly examining each watershed individually to document their current state. The first of the watersheds documented was the Cromwell Brook Watershed, which was done via photography and audio recordings by WPI's own IQP team in 2015 (Amato, Googins, Kessler, Morrison, 2015). The photographic and audio documentation of the prior IQP set up an ecological baseline of the watershed. Unfortunately, the audio recordings were deemed ineffective and not repeatable due to human error and the lack of proper equipment and time. With the conclusion of the 2015 documentation, the efforts of this project were directed toward the Marshall Brook Watershed. The baseline photography done previously in the Cromwell Brook set a precedent to the documentation of the current team's ecological documentation of the Marshall Brook Watershed as seen in Figure 3.

***Figure 3**: Photos from the Cromwell Watershed Team*

Section 2.3.1 Repeat Photography

The visual baseline that has been established for the current state of the Marshall Brook Watershed will be used in conjunction with repeat photography in order to track the changes of ecosystems in the watershed. Repeat photography is defined as "the art of finding the site of a previous photograph, reoccupying the original camera position, and making a repeat photograph of the same scene." (Skovlin, Thomas, 1995)

The first documented instance of using repeat photography for scientific and ecological use was performed by Sebastian Finsterwalder in 1888. He took photographs from the same camera stations over a duration of 14 years to document the change in glaciers. (Webb, Boyer, Turne, 2010) Currently, repeat photography is used to gather data from all around the world by organizations such as the United States Geological Survey (USGS) and the Forest History Society (FHS). "When combined with other data from repeat photographs can provide wide-ranging insights into changes over time in ways that could not be achieved otherwise." (Webb, Boyer, Turne, 2010)

A repeat photography project has been in process since 1997 in Glacier National Park. This project has proven that repeat photography is useful in tracking glacial recession which can be seen in Figure 2 below. (Ackley, 2018)

Figure 4: *Repeat Photography of Grinnell Glacier 1926 (left) vs. 2008 (right)*

Another example of repeat photography at work can be seen in Figure --. These photos was taken in Acadia National Park on the Tarn Dam as a part of a project associated with the *Wild Acadia Initiative.*

Figure 5: *Repeat Photography of The Tarn Dam 1918 (left) vs. 2015 (right)*

Repeat photography has also become an "invaluable asset to help understand the effects of climate variation and land-use practices on arid and semiarid environments." (Webb, Boyer, Turne and Bullock, 2007) It is used by various organizations and individuals as a tool for restoring damaged ecosystems. These ecosystems have suffered from degradation due to human interaction. Combining repeat photography and ecosystem restoration allows for preservation efforts to be directed at observable changes (Byers, 1987).

While there are many different examples of using repeat photography for environmental conservation, an exact and universal technique has not been solidified. "The precision of repeat photography sets can vary depending on whether the photographer takes pains to capture the subject from the exact same location, time of year, camera angle and with similar weather conditions as were present in earlier photos." (Pezzoni, Howard, Lehman, 2018) For each application of repeat photography the techniques and methods must be tailored to the specific environment and what changes the observer is trying to see.

Section 2.3.2 Underwater Photography

As the name entails, underwater photography is the process of taking photos underwater. It allows photographers to capture that which cannot be seen on land and also has the ability to be used in many applications such as conservation efforts. For the Marshall Brook Watershed, the team decided to use underwater photography as a way to document water conditions of its streams and tributaries. It is new and uncharted territory but carries much importance because

much like repeat photography, underwater photography can document changes in the quality of water over time. Water quality is an indicator of the health of a watershed as stated by the Environmental Protection Agency (EPA) a healthy watershed should be able to support the "physical and chemical water quality conditions" (2015). Therefore, the clarity or turbidity of the water in the watershed can tell many details such as different organic compounds and sediments in the water which affect the watershed's health.

Chapter 3: Methodology

Section 3.1 Recreating Cromwell Brook's Photos

During a period of preliminary research, the team found that the IQP "Photographic Documentation of the Cromwell Brook Watershed" (2015) had goals very similar to the overall goal of this project. After viewing the associated report, it seemed that the 2015 project yielded useful results through a reliable method. This team was therefore inclined to approach this project in a similar fashion. It was unknown, however, whether the 2015 method could be followed a second time to produce adequate replicas of the original photos. Therefore, an in-field review of the methods used in the Cromwell Brook Watershed was conducted. This was done by following the methods detailed in the 2015 IQP report to recreate a sample of the photos taken in the Cromwell Brook Watershed. Once the photos were replicated they were compared side by side with the originals for accuracy in framing, angle, and lighting. If the photos were accurate to these dimensions it would be clear what ecological changes occurred since the original photos were taken. If no changes occurred, the images were expected to be identical to their originals. This analysis ultimately highlighted what aspects of the Cromwell methodology needed to be improved. Once these improvements were identified, they were integrated into the original methodology and put to use in the photographic documentation of the Marshall Brook Watershed.

When the Cromwell Brook Watershed project was in its initial stages, approximately 60 locations for photographic documentation were provided by Acadia National Park on the map as seen in Figure 3. These locations were places the Park considered ecologically concerning or relevant to the preservation of the Cromwell Brook Watershed. Due to a limited time frame, this review did not recreate all sixty locations. Therefore, five locations were chosen for reproduction based on ease of accessibility.

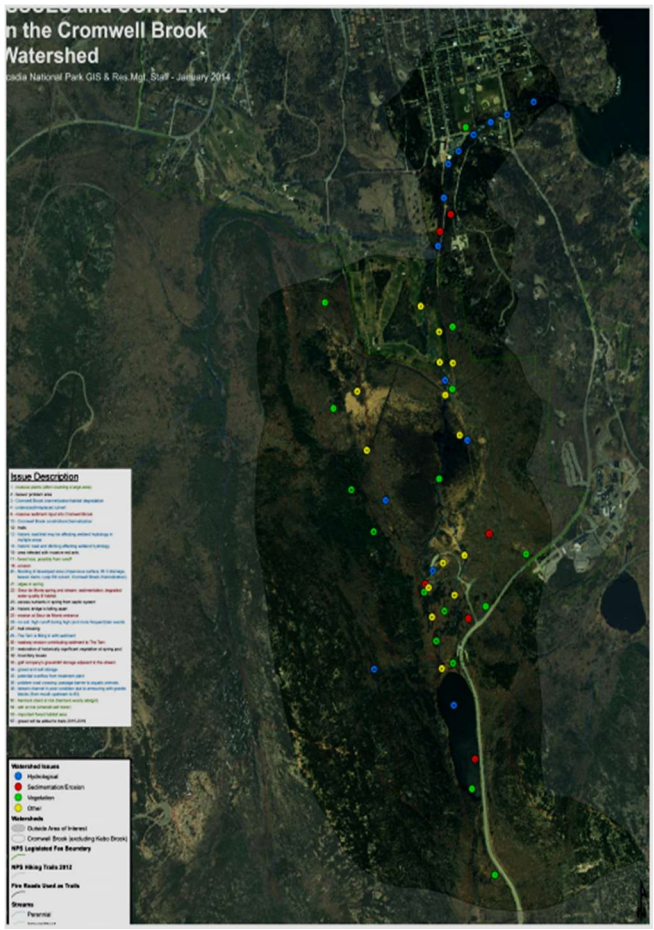


Figure 6: *Cromwell Brook Watershed Photo Point Map*

(Amato, Googins, Kessler, Morrison, 2015, pg. 17) (See enlarged version in appendix, A2).

Section 3.2 Marshall Brook Site Selection

Once the review of the Cromwell Brook Watershed methodology was completed, work within the Marshall Brook Watershed began. The Park had identified points of interest within the watershed to be documented. A map was also provided which contained the general locations of the selected sites to guide the photographic documentation of the area (Fig. 4). GPS coordinates were not indicated on the map, therefore exact latitude and longitude of each location were extrapolated by opening the map file and viewing the coordinates in Google Earth. The specific

objects photographed at each location were chosen for their distinctiveness in order to ensure that the photo points can be easily found by future photographers.

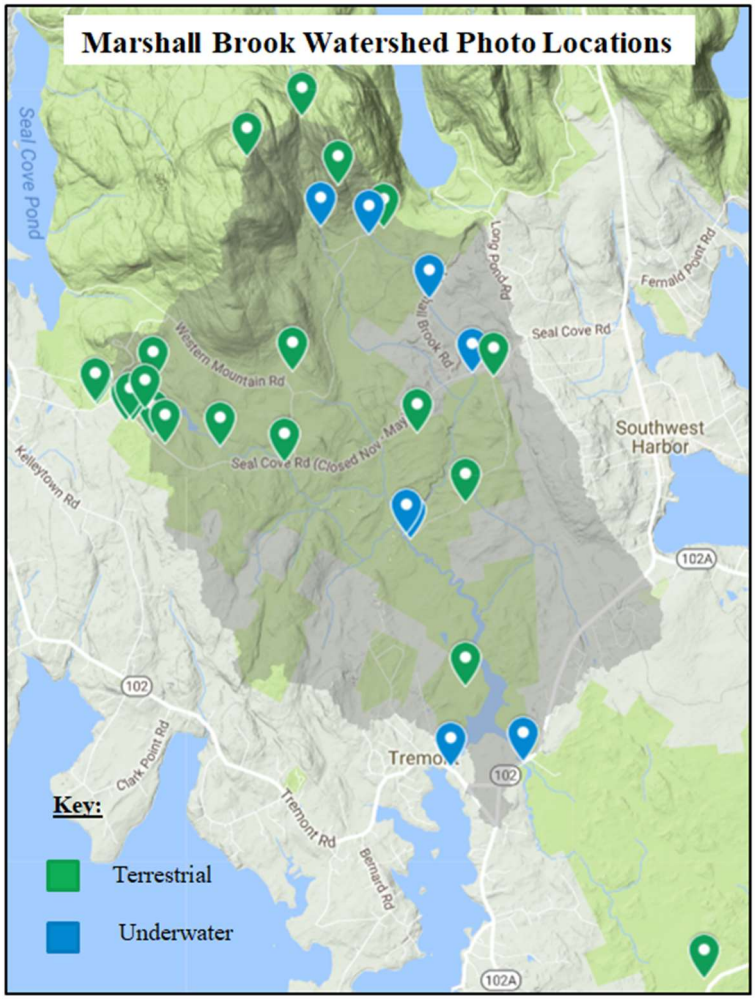


Figure 7: *shows the map of the Marshall Brook Watershed provided by Acadia National Park. Includes boundaries and points of interest for photographic documentation*

(See *enlarged version in appendix, A3*)

Section 3.3 Photographic Methods

As stated in section 3.1, the first step to creating a methodology for the documentation of The Marshall Brook Watershed was to repeat a portion of the Cromwell Brook photographs using their methodology. This allowed for an improved understanding of the essential components of repeat photography. These aspects encompass the allowable tolerances for the data collected in regards to camera location and the level of detail needed to properly describe a photograph site that could only be attained by repeating photographs.

The Cromwell Brook methodology called for 13 various measurements to be taken that detailed the camera's setup and surrounding aspects. These measurements include date, time of day, GPS coordinates, the direction of the compass, photo location, file name, photo type, a description of the surrounding area, tripod height, front leg length, back legs length, weather, and camera zoom. The Cromwell Brook methodology also incorporated taking photographs of the camera setup at each photo location for future reference. Each photo was then organized into a Google Sheets document with its corresponding information (Fig. 5). A master list had also been created to keep track of the group's progress throughout their time at Acadia (Fig. 6) (Amato, Googins, Kessler, Morrison, 2015). The Marshall Brook Watershed group used this methodology when recreating the Cromwell Brook Watershed photographs.

Date	Time	GPS	Photo Location	Photo Filename	Type	Compass Azimuth	Tripod Height (in)
6/16/15	1:45	44 21' 46.0" N 68 12' 21.0" W	2	P1000044.JPG	Single	110	41.9
6/16/15	1:52	44 21' 46.0" N 68 12' 21.0" W	2	P1000045.JPG	Panoramic	55-200	41.9

Lead Leg (in)	Back Legs (in)	Zoom (mm)	Weather	Description
N/A	N/A	25	Light rain, medium fog	between service road and cromwell brook, near beaver lodge
N/A	N/A	25	Light rain, medium fog	between service road and cromwell brook, near beaver lodge

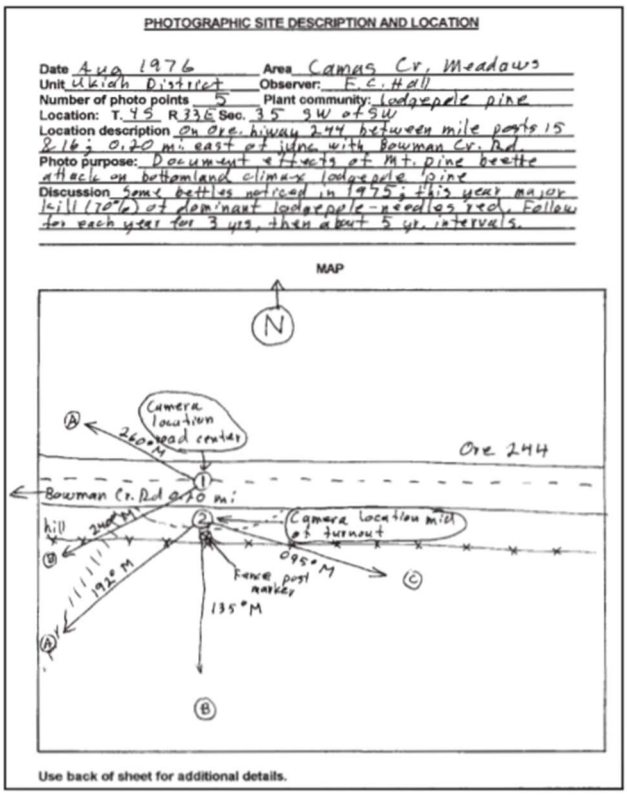
Figure 8: *Data Table Example (Amato, Googins, Kessler, Morrison, 2015)*
(See enlarged version in appendix, A4)

Photopoint	Status	Notes	Complete	Uncertain
1 (In The Tarn)	Complete		38	2
1 (Near Route 3)	Don't worry	Invasive species team took care of this		
1 (Near Town Tennis Courts)	Complete		Not Done	Don't Worry
1 (Near Jesup Path)	Don't worry	Invasive species team took care of this	2	8
1 (Immediately South of The Tarn)	Don't worry	Invasive species team took care of this		
1 (Wicked South of The Tarn)	Don't worry	Invasive species team took care of this	Updated for 7/6	
1 (Middle of the Great Meadow)	Don't worry	Invasive species team took care of this		
1 (Near Point 2 in Great Meadow, 10)	Don't worry	Invasive species team took care of this		
1 (Near 15 in Great Meadow Loop Trail)	Don't worry	Invasive species team took care of this		
2 (In Great Meadow, Near Park Loop Road)	Complete			
2 (Near Sieur De Monts)	Complete			
2 (North of Point 32)	Complete			
2 (South of Point 32)	Complete			
3	Complete			
4 (Near Golf Course Gravel Storage)	Complete			
4 (North of Point 6)	Complete			
6	Complete			
10	Complete			
12	Complete			
13	Uncertain	Hydrology, needs clarification		
14	Complete			
15 (Near Point 14)	Complete			
15 (Great Meadow Loop Trail)	Complete			
17	Complete			
18	Complete			

Figure 9: *Cromwell Photo Point Master List*

(See enlarged version in appendix, A5)

While recreating the Cromwell photos, research was done to reveal additional repeat photography methods to improve the repeatability of the photos. One method used in the past by the United States Forest Service was to place meter sticks near points of interest and focus the center of the photograph on them. The meter sticks were then left at the site after the photo was taken and could be used for refocusing in the future. The camera was always placed at a specified distance from the marker. This allowed for a grid system to be overlaid onto the photos to determine dimensions of objects such as wildlife, shrub height or other details. A form was also created in order to give an overview of the site setup (Figure 10) and copies of photographs were created with labels on important features that could have been used to relocate the photographs (Figure 11) (Hall, 2002).



PHOTOGRAPHIC SITE DESCRIPTION AND LOCATION

Date Aug 1976 Area Camas Cr. Meadows
Unit Ukiah District Observer: F.C. Hall
Number of photo points 5 Plant community: lodgepole pine
Location: T. 4S R 33E Sec. 35 SW of SW
Location description On Ore. highway 244 between mile posts 15 & 16; 0.70 mi. east of junc. with Bowman Cr. Rd.
Photo purpose: Document effects of Mt. pine beetle attack on bottomland climax lodgepole pine
Discussion Some kettles noticed in 1975; this year major kill (70%) of dominant lodgepole - needles red. Follow for each year for 3 yrs, then about 5 yr. intervals.

MAP

Use back of sheet for additional details.

Figure 10: *Photograph Site Form (Hall, 2002) (See enlarged version in appendix, A6).*

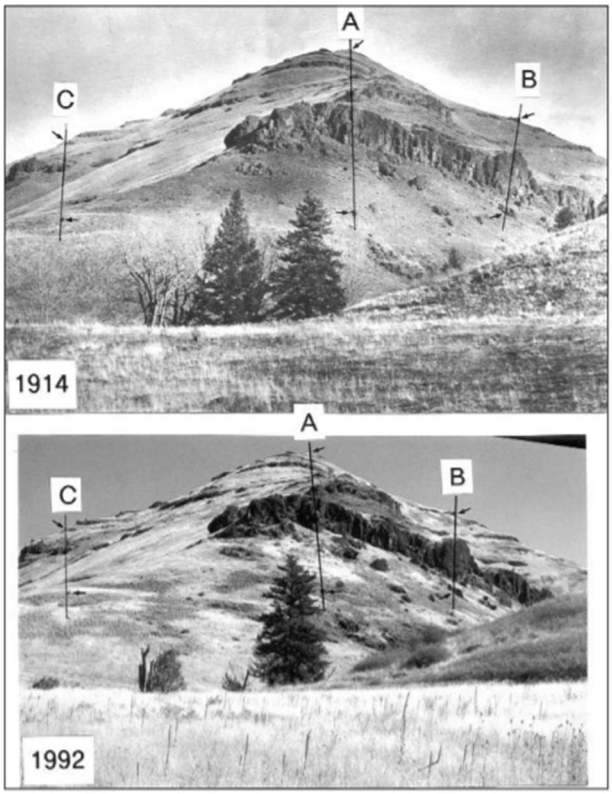


Figure 11: *Labeled Photograph (Hall, 2002) (See enlarged version in appendix, A7)*

The United States Geographical Survey had a protocol for the recreation of a photo. It was recommended to gather as much data as possible about the given photo and to highlight important features and their location inside the photograph. Additionally, one should bring the photo being recreated for reference. Timing was very important and it was recommended that one planned ahead and tried to recreate the photo at a similar time of year to when it was taken (USGS, 2016). This research was used in conjunction with the Cromwell Brook Watershed methodology to develop the methods that were implemented in the documentation of the Marshall Brook Watershed.

Section 3.3.1 Underwater Photography

In order to establish a baseline for underwater clarity, the team submerged a camera to capture underwater pictures in the watershed. While underwater photography techniques are commonly used for environmental research, they are not often used in the context of repeat

photography. Typically underwater photography focuses on recording and conveying the diversity and beauty of underwater life to the public. This is used to spark the public's curiosity and interest in underwater environments in order to try and promote conservation efforts and ideas. (Strobel, 2017)

Various points along the Marshall Brook Watershed were targets for underwater photography. The goal of underwater photography in the watershed is to look at differences in water clarity at different points along the watershed. These points could include two brooks merging, or stormwater runoff points. Repeat photography is a challenge underwater, the team determined a more relaxed approach would be most beneficial compared to repeat photography done above water. This relaxed approach provides a general location where underwater photos can be taken. Where above water, extensive details are provided to get exact photograph locations for the purpose of repeat photography as seen in Figure 12.

Figure 12: *Underwater photo setup*

Section 3.4 Equipment Selection

The equipment for this projects was of the utmost importance because it dictated how the photos will be recreated for the years to come. So, this section extensively documented the equipment and practices used to care for the equipment.

Section 3.4.1 Camera Selection

Figure 13: *Canon 6D camera (See enlarged version in appendix, A8)*

The most important equipment to this project was the cameras used to take the photographs of the areas of ecological concern. The team chose to use an easily purchasable, commercially available Canon 6D camera, shown in Figure 13, for the terrestrial photographic documentation.

This camera utilizes a full frame format and is capable of capturing extremely detailed, high-resolution photographs. A 50mm prime lens was used with the Canon 6D to create a fixed zoom at 50mm with a consistent focal length for every photograph. All of these features were essential to establishing a foundation for reliable repeat photography. In addition to the Canon 6D, the

Figure 14: *Lumix FZ-1000 Camera (See enlarged version in appendix, A9)*

group also used the backup Panasonic Lumix shown in Figure 14. This camera was originally

used as the primary camera for the repeat photography of the Cromwell Watershed in 2015. It was again used to take setup pictures during the photography of photo points in the Marshall Brook Watershed.

During the underwater photographic documentation a GoPro Hero 4 Black, shown in Figure 15, was used along with an underwater light attachment (Figure 16) for high-quality images and clear visibility underwater. It is also a commercially available camera that can be easily purchased for replication purposes.

Figure 15: *GoPro Hero 4 camera*

(See enlarged version in appendix, A10)

Figure 16: *GoPro Underwater Light*

(See enlarged version in appendix, A11)

Section 3.4.2 GPS Selection

As a part of the photo documentation process, GPS coordinates were taken at each photo location using a Garmin E-Trex H GPS unit (Figure 17). This unit was chosen on the basis of

Figure 17: *Garmin E-Trex GPS*

(See enlarged version in appendix, A12)

availability and consistency since it was used by the previous Cromwell Brook Watershed team. This unit also had a reasonable battery life, high accuracy, durability and the ability to store waypoints.

Section 3.4.3 Weather Protection

In order to accurately document the ecology of the Marshall watershed, it was imperative that all equipment was kept in good working condition. To prevent any damage to the very expensive non-waterproof cameras during inclement weather, the Canon 6D was covered with a weather cover as seen in Figure 18.

Figure 18: *DSLR weather cover*

Section 3.4.4 Data Storage

The storage of the Marshall Brook Watershed's photos is important for future repeat photography in the area. Many photos were taken over the course of the IQP, so as to ensure that the photos taken were organized and stored, backups were done on an external hard drive nightly. These daily backups prevented a backlog of pictures because of the time it takes to upload high-quality pictures. At the end of the project, all of the photos were given to Acadia National Park on the single external hard drive.

Section 3.4.5 Miscellaneous Equipment

. Other equipment including a lightweight tripod, compass, and measuring tape (Figures 19 and 20) was important to the creation of the repeat photography methodology. The tripod allowed for the camera to remain stable while taking photos while the compass and tape measure ensured it was the correct height and direction. Additionally, a light-weight grading rod was utilized as a height reference in each of the team's photographs, which can be seen in Figure 21.

Figure 19: *MeFoto A1350 Aluminum Tripod*

(See enlarged version in appendix, A13)

Figure 20: *Compass and measuring tape*

(See enlarged version in appendix, A14)

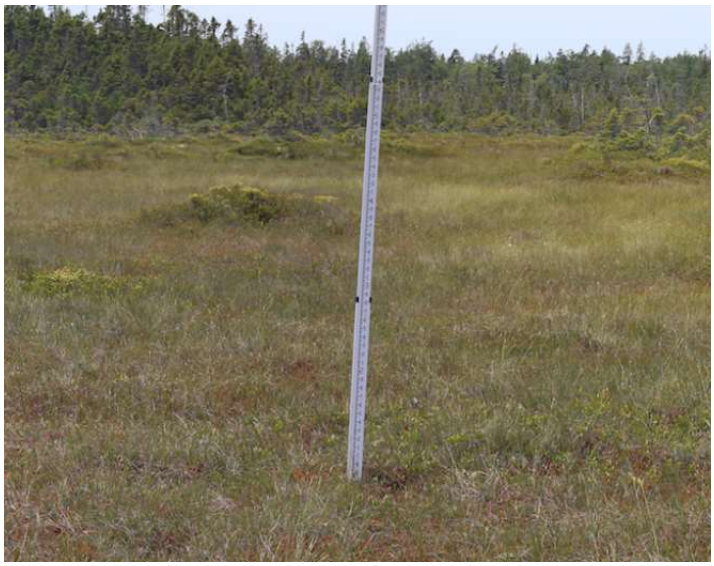


Figure 21: *Grade Rod in the Field*

Section 3.5 Ethics

Section 3.5.1 Leave No Trace

Leave No Trace is a program designed to promote practices that minimize human impact during hiking and camping excursions. It has seven simple principles that are designed to be easy to follow. (Leave No Trace Program, 2012) The team attempted to incorporate these principles into the methodology being developed in order to minimize the impact they had during data collection:

1. **Plan Ahead and Prepare** means to do things such as planning for inclement weather, being aware of environmental concerns in an area, being self-sufficient and being properly equipped for one's journey.
2. **Travel and Camp on Durable surfaces** state that one must travel on well-defined paths, hard surfaces such as rock or snow. It is preferred to camp on places with minimal groundcover so as not to destroy plant life. The group should pay particular attention to setting up the tripod and camera on surfaces that will not be damaged by a group of 4 students walking around it for an extended period of time.
3. **Dispose of Waste Properly** can be defined as packing in and out everything you need and to make sure holes for human waste are properly dug and located 200 ft. from a river, marsh, campsite or trail.

4. **Leave what you Find** is outlined in order to not disturb the ecology of the ecosystem. One should not remove things such as branches, rocks, animal bones or other natural items one comes across for any reason.
5. **Minimize Campfire Impacts** is to help prevent accidental wildfires and protect campsites and animal life.
6. **Respect Wildlife** dictates that visitors must not interact with, feed, harass or approach wildlife in any shape or form.
7. **Be considerate of Other Visitors** is a general rule to make the parks more enjoyable for everyone who uses them. Groups or individuals should take breaks away from hiking paths and out of sight of others, try to keep their volume down because sound travels very far, make way for others to use the trails and just be cognizant of their impact.

Chapter 4: Results & Analysis

Section 4.1 Repeat photography in the Cromwell Brook Watershed

After repeating the sample of photos from the Cromwell Brook Watershed, two main observations were made concerning the use of repeat photography to aid *Wild Acadia*. First, distinct changes could be seen when comparing the original and repeated photos despite the very short time difference between them. Figures 22 and 23 show a beaver dam near the Sieur de Monts visitor center.

Figure 22: *Original photo of the beaver dam near Sieur De Monts. Taken in 2015*

Figure 23: *Repeated photo of the beaver dam near Sieur De Monts. Taken in 2018*

A simple side-by-side comparison of these photos reveals several differences. In the original shot, the water comes all the way up to the dam, the dam itself looks freshly made and a small clump of leaves is growing from the front edge. In the 2018 shot, the water level is significantly lower, the dam is decayed and the small clump of leaves has grown into a small tree. Even over such a small time frame significant change has already occurred in this area. Secondly, this was not the only site that exhibited change. From the sample of five locations, two others showed evidence of changes occurring in the Cromwell Brook Watershed. Figure 24 shows vegetation advancing at the head of the Tarn Dam and Figure 25 shows the successful reconstruction of a stream bank behind the Sieur De Monts visitor center. Although the original

Cromwell Brook photos were taken very recently and only a small number of photos were repeated, these comparisons prove it would be beneficial for *Wild Acadia* to continue repeat

Figure 24: *Repeat Photography of the Tarn Dam 2015 (left) vs. 2018 (right)*

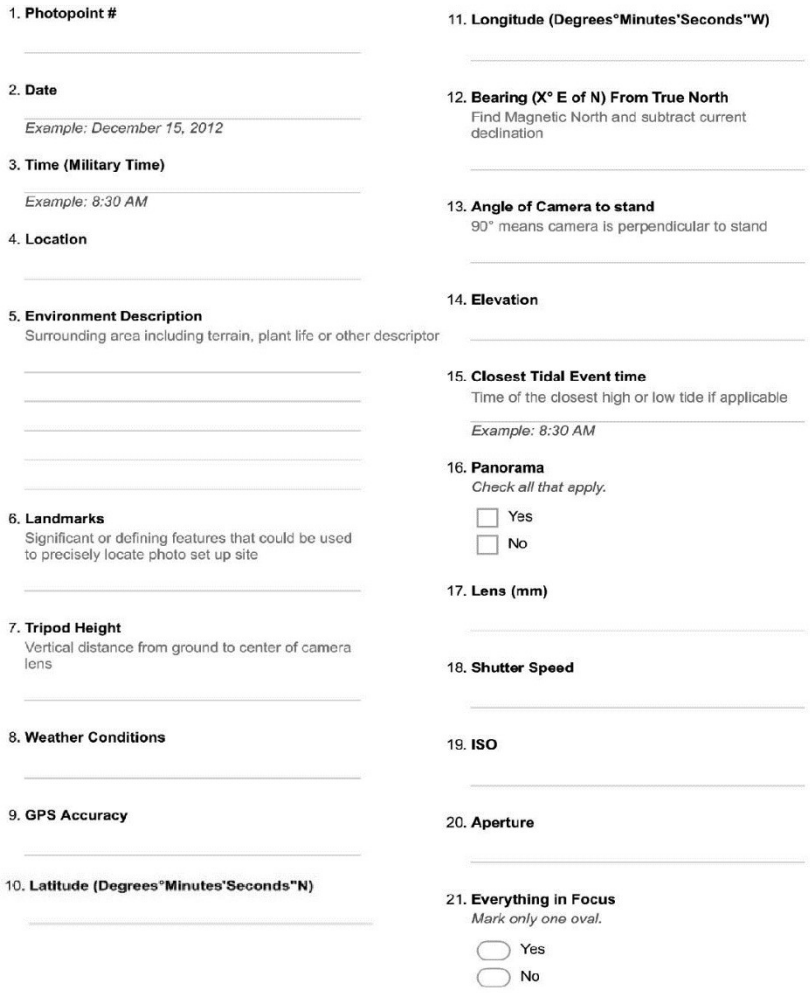
photography in Acadia's watersheds. If the Park were to commit to long-term, in-depth, repeat photography studies of its watersheds a wealth of information could be found concerning what is causing changes in Acadia National Park.

Figure 25: *Reconstruction of Stream Bank 2015 (left) vs. 2018 (right)*

Section 4.2 Methodology Improvement

As the team completed the repeat photography of the Cromwell Brook Watershed, much was learned from the process and photos. These photos were repeated by utilizing the Cromwell team's Lumix camera, data table, shown in Figure 8, their original photos and setup photos. The data table was especially important because it included the key data about the photos capture, such as time, date, and GPS location, which allowed the camera to be placed in approximately the same place. However, if additional data was collected describing the conditions under which the photos were taken, the replication of these photos would have been much easier and more

accurate. Therefore, a more comprehensive and detailed documentation was created for the methodology of the Marshall Brook Watershed.



1. **Photopoint #**

2. **Date**

Example: December 15, 2012

3. **Time (Military Time)**

Example: 8:30 AM

4. **Location**

5. **Environment Description**
Surrounding area including terrain, plant life or other descriptor

6. **Landmarks**
Significant or defining features that could be used to precisely locate photo set up site

7. **Tripod Height**
Vertical distance from ground to center of camera lens

8. **Weather Conditions**

9. **GPS Accuracy**

10. **Latitude (Degrees°Minutes'Seconds"N)**

11. **Longitude (Degrees°Minutes'Seconds"W)**

12. **Bearing (X° E of N) From True North**
Find Magnetic North and subtract current declination

13. **Angle of Camera to stand**
90° means camera is perpendicular to stand

14. **Elevation**

15. **Closest Tidal Event time**
Time of the closest high or low tide if applicable

Example: 8:30 AM

16. **Panorama**
Check all that apply.
- [ ] Yes
- [ ] No

17. **Lens (mm)**

18. **Shutter Speed**

19. **ISO**

20. **Aperture**

21. **Everything in Focus**
Mark only one oval.
- ◯ Yes
- ◯ No

Figure 26: *Repeat Photography Data Sheet*

(See enlarged version in appendix, A15)

The data sheet the team developed included important data such as landmarks, tides, and the compass bearing of the camera as seen above in Figure 26. A *Rite in the Rain* notebook was utilized to record the data in each photo location seen in Figure 27.

Figure 27: *Team notebooks for documentation in the field*

(See enlarged version in appendix, A16)

Additionally for each photo point, a panorama and single shot photo were taken along with many setup photos. The panoramic photographs were new and innovative to the repeat photography process. It allowed for easier repeat photography because one does not need to zoom with the camera itself which make the replication process easier. To create these panoramas, smaller photos of the area were taken and stitched together. The panoramic photo allows those viewing the photo the ability to see view large spans of the area while allowing for in detail zooms. These panoramas consisted as few photos as 9 to as many as 35 depending on the photo point and its surroundings.

Landmarks are particularly important to the repeat photography process because they aid in locating the exact place where the original photographer placed the camera. The team often used rocks or manmade structures as landmarks because such items remain unchanged and recognizable for long periods of time. Another data point of great importance was the noting of tides, which was unique to this watershed because of the tidal influence on some of the area. For the areas

affected, photos were taken during the tide's highest and lowest times in order to capture the tidal influence on the area. Lastly, the bearing of the camera was taken to allow for accurate pictures in areas with repetitive surroundings. In such locations there are very few distinct landmarks to note, therefore, bearing indicates the correct direction for the camera to be pointed. All of this data affords the future researchers a much quicker and easier time when repeating the photographs as well as ensuring the accuracy of the repeated photo.

In addition to the improved data documentation, a field guide was created to streamline the repeat photography and photography process.

Repeat Photography Field Guide

Before you go:

1. Print out all possible set up photos, repeat photos and any applicable data or photos related to the specific photo location you're going to.
2. Analyze photos for specific landmarks that may still be visible i.e. man-made structures, large rocks or bodies of water.
3. Check your equipment to make sure it is both charged and similar to that used by the previous photographer.
4. Identify sites on a map and create a route to travel to each specific photopoint.

In the Field:

1. Using a map and gps, navigate to area of the photo your going to repeat.
2. Once at the photopoint, use the set up photos and repeat photo to determine what was photographed and where the tripod was located.
3. Set the tripod up at the point determined in previous step and use data such as tripod height and compass bearing to align camera in general direction.
4. Identify distinctive features around the edge of the photograph to be repeated and their relative distance to both each other and the edge of the photo.
5. Look through the camera lens to look for these features such as a split tree, boulder, rock formation, stream or embankment in their current state and attempt to locate them a similar distance to the edge of the camera's view.
6. When you are satisfied and believe that you have accurately recreated the photo to the best of your abilities, zoom out slightly if possible and take the picture.
7. Record all extraneous details and data and record set up photographs for the next photographer.

Back at Base:

1. Backup all photos and record and organize all the data, setup photos and old photos as necessary.
2. Compare the initial and repeat photos for accuracy as well as change.
3. If photos are not accurate enough, take note of differences and return to field and try again.

Figure 28: *Repeat Photography Field Guide (See enlarged version in appendix, A17)*

This guide as seen in Figure 28 included step by step instructions on creating and recreating photographs out in the field along with tips on how to make the photos more easily replicated.

Section 4.3 Repeatability

After implementing and using the improved methodology and field guide, the team went back to four photo locations in the Marshall Brook Watershed to prove the repeatability of the methodology. This was extremely important to the project because this methodology will need to be repeated many years from now, so this methodology needs to produce photos very similar to the ones taken originally.

Figure 29: *Improved Road Crossing Original (Left) and Repeat (Right)*

Figure 30: *Adams Bridge Original (Left) and Repeat (Right)*

As a result of the improved methodology, the team was easily able to locate the previous location via the GPS and utilize the recorded location data to accurately find the placement and direction of the camera. The photographs in Figures 29 and 30 show that the improvements made to the methodology allowed for photos to be more repeatable.

Section 4.4 Photographic Documentation of the Marshall Brook Watershed

The following is a collection of photos from each location documented in the Marshall Brook Watershed. Each entry includes a single shot, a panorama, and a setup photo as well as the data table relevant to the given photo point. In Figure 31, a full numbered documentation of photo locations can be found with references to all forty-nine photo points which can be found in Appendix A4. This does not serve as a comprehensive record of all the photos taken over the course of this project. Instead, these photos represent the highlights of each location. The full compilation of photos was given to Acadia National Park on a hard drive as discussed in section 3.4.4.

Marshall Brook Photo Location Data

	Photo Locations	Photo Point #s	Effected by tide	Underwater
1	Adam's Bridge With Views Into Bass Harbor Marsh	1,2,5,6,49	Yes	
2	Bridge Impact on Tidal Marsh	3,4,7,8,44	Yes	
3	Degraded Wetland Condition Due to Road Crossing	9,10,43	Yes	
4	High Quality Wetlands at Improved Road Crossing	11,12,42	Yes	
5	Lower End of Wetland	13		
6	Upper End of Wetland	14		
7	Kelly Cemetery	17		
8	Cultural Remnants of Salt Marsh Farming	16		
9	Big Heath Wetland	15		
10	Clear Cut East of Trail	28		
11	Very Old Cedar Swamp (Trees aged at 200 years)	18		
12	Upper End of Bass Harbor Marsh and Limit of Tida	26,31,46	Yes	
13	CCC Constructed Reservoir	20,21, 41		
14	Cultural Resource	19		
15	Overlook	22,23		
16	Overlook along Trail	25		
17	Watershed Divide	24		
18	Marshall Brook Tributaries	29		
19	Blacksmith Building (Standing)	27		
20	Looter's Hole	30		
21	Marshall Brook- Pre-China Hill	45		
22	Marshall Brook- Marshall Brook Rd Crossing	32,47		
23	Marshall Brook- Mill Road Crossing	33,48		
24	Mary Nurwoods Grave	37		
25	Dump 2	39		
26	House Cellar	38		
27	Unknown Huge Round Depression	34		
28	Dump 1	36		
29	Well 1	35		
30	Cellar 1	40		

Figure 31: *Photo Location Data with references to photo points*

Marshall Brook Photo Point Data

Photo Location 1: Adam's Bridge with View into Bass Harbor Marsh

Photo Location 2: Bridge Impact on Tidal Marsh

Photo Location 3: Degraded Wetland Condition Due to Road Crossing and Adjacent Activities

Photo Location 4: High-Quality Wetlands at Improved Road Crossing

Photo Location 5: Lower End of Wetland

Photo Location 6: Upper End of Wetland

Photo Location 7: Kelly Cemetery

Photo Location 8: Cultural Remnants of Salt Marsh Farming

Photo Location 9: Big Heath Wetland

Photo Location 10: Clear Cut East of Trail

Photo Location 11: Very Old Cedar Swamp (Trees aged at 200 years)

Photo Location 12: Upper End of Bass Harbor Marsh and Limit of Tidal Influence

Photo Location 13: CCC Constructed Reservoir

Photo Location 14: Cultural Resource

Photo Location 15: Overlook

Photo Location 16: Overlook along Trail

Photo Location 17: Watershed Divide

Photo Location 18: Marshall Brook Tributaries

Photo Location 19: Blacksmith Building (Standing)

Photo Location 20: Looter's Hole

Photo Location 21: Marshall Brook- Pre-China Hill (Underwater)

Photo Location 22: Marshall Brook- Marshall Brook Rd Crossing

Photo Location 23: Marshall Brook- Mill Road Crossing

Photo Location 24: Mary Nurwoods Grave

Photo Location 25: Dump 2

Photo Location 26: House Cellar

Photo Location 27: Unknown Huge Round Depression

Photo Location 28: Dump 1

Photo Location 29: Well 1

Photo Location 30: Cellar 1

Chapter 5: Conclusions & Recommendations

In summary, this project has aided Acadia National Park in initiating a preservation effort within the Marshall Brook Watershed by establishing the beginnings of repeat photography in the area. After repeating the photos taken by the Cromwell Brook IQP, the following two conclusions were made:

1. Long-term repeat photography would be beneficial to *Wild Acadia's* watershed-by-watershed approach to conserving and preserving Acadia National Park.
2. The repeat photography process is made easier and more reliable when the locations and circumstances associated with each photo are documented in comprehensive detail.

Based on the second conclusion, a methodology was developed for the photographic documentation of the Marshall Brook Watershed. This methodology, succinctly presented in a field guide, featured the collection of a wide range of data about each photo point, as well as the use of a grade rod and a high-resolution camera.

From the photos produced in the Marshall Brook Watershed, four were repeated to prove that the developed methodology was repeatable. While it was relatively easy to replicate the photos a second time, it was noted that at times the latitude and longitude coordinates recorded by the Garmin GPS unit were not always accurate to the coordinates of points on the Google Earth photo location map. Therefore it is recommended that future repeat photography teams navigate to the general location of each photo point using a copy of the map in the Google Maps application. The exact location can then be found using the appropriate setup photos and the Garmin GPS unit. For teams conducting initial photography for an area, it is recommended that a GPS unit with higher accuracy is used. It was also found that at certain locations the ground was not soft enough for the grade rod to stand on its own. As a result, a member of the team had to be present in some photos to hold the rod.

Additionally, the team discovered a myriad of undocumented cultural resources in an area referred to by the Park as "The Old Homestead". These new sites create an opportunity for scientists to use the repeat photography improved methodology to document the homestead area. In the future, it is recommended that teams make a portable stand to support the grade rod,

continue the repeat photography of all the watersheds on Mount Desert Island, and utilize repeat photography to continue the documentation of more of the homestead site.

Finally, the methodology developed by this project can be extended to other areas of Acadia National Park. As Wild Acadia moves forward, this methodology will be important to supporting future repeat photography studies in other watersheds and to continuing the work that has been initiated in the Cromwell and Marshall Brook Watersheds.

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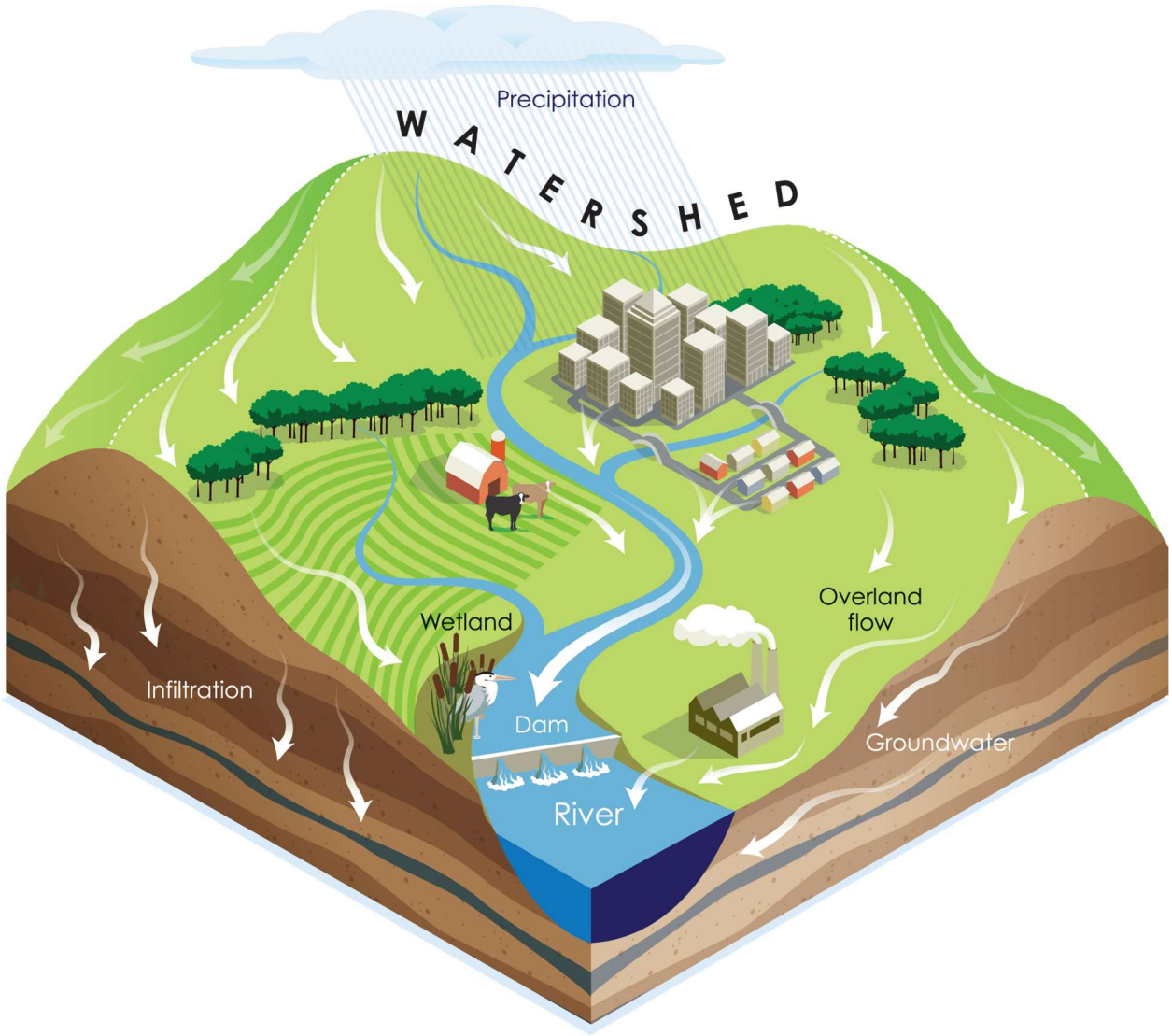
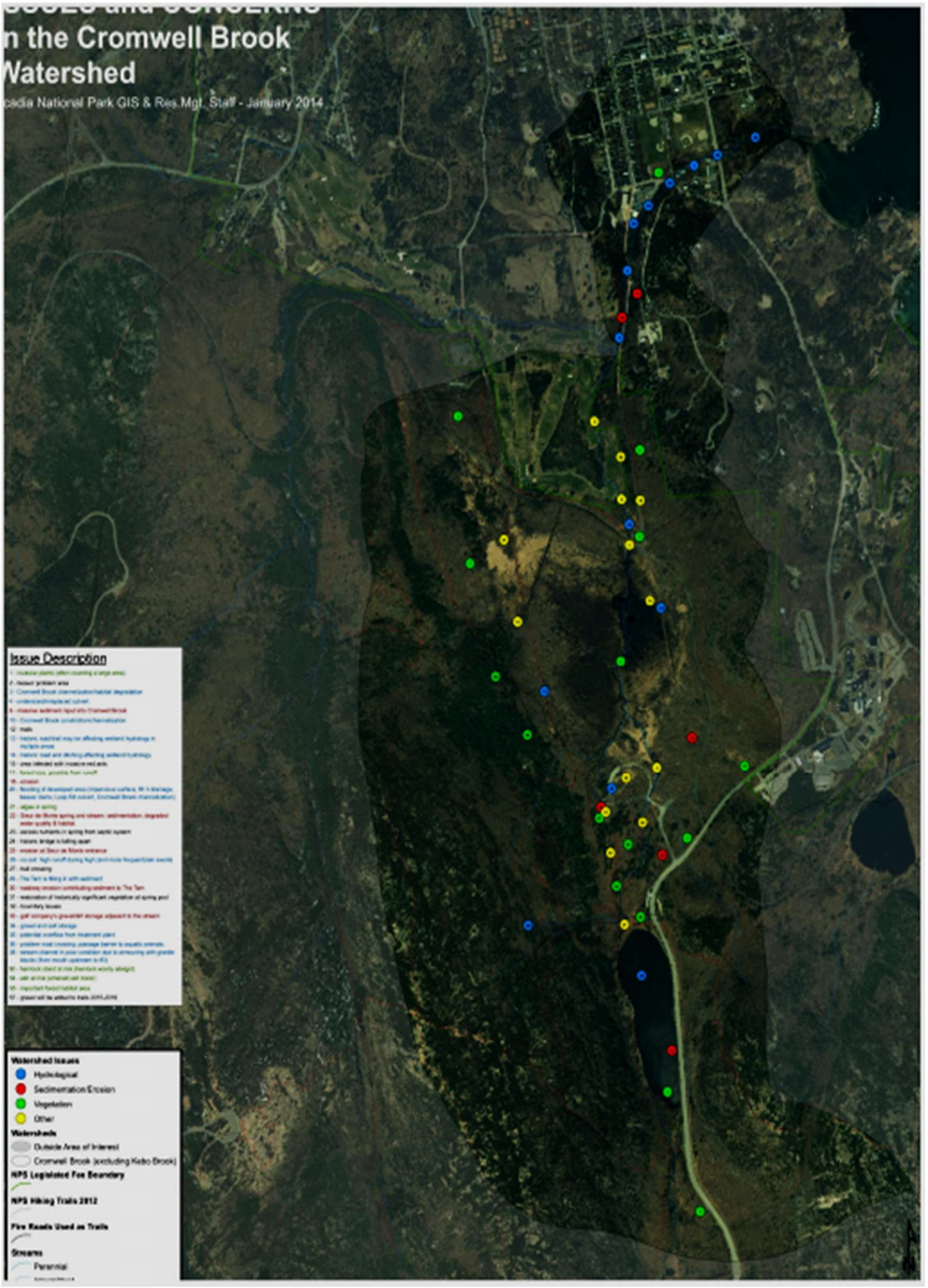
Appendix A: Enlarged Figures

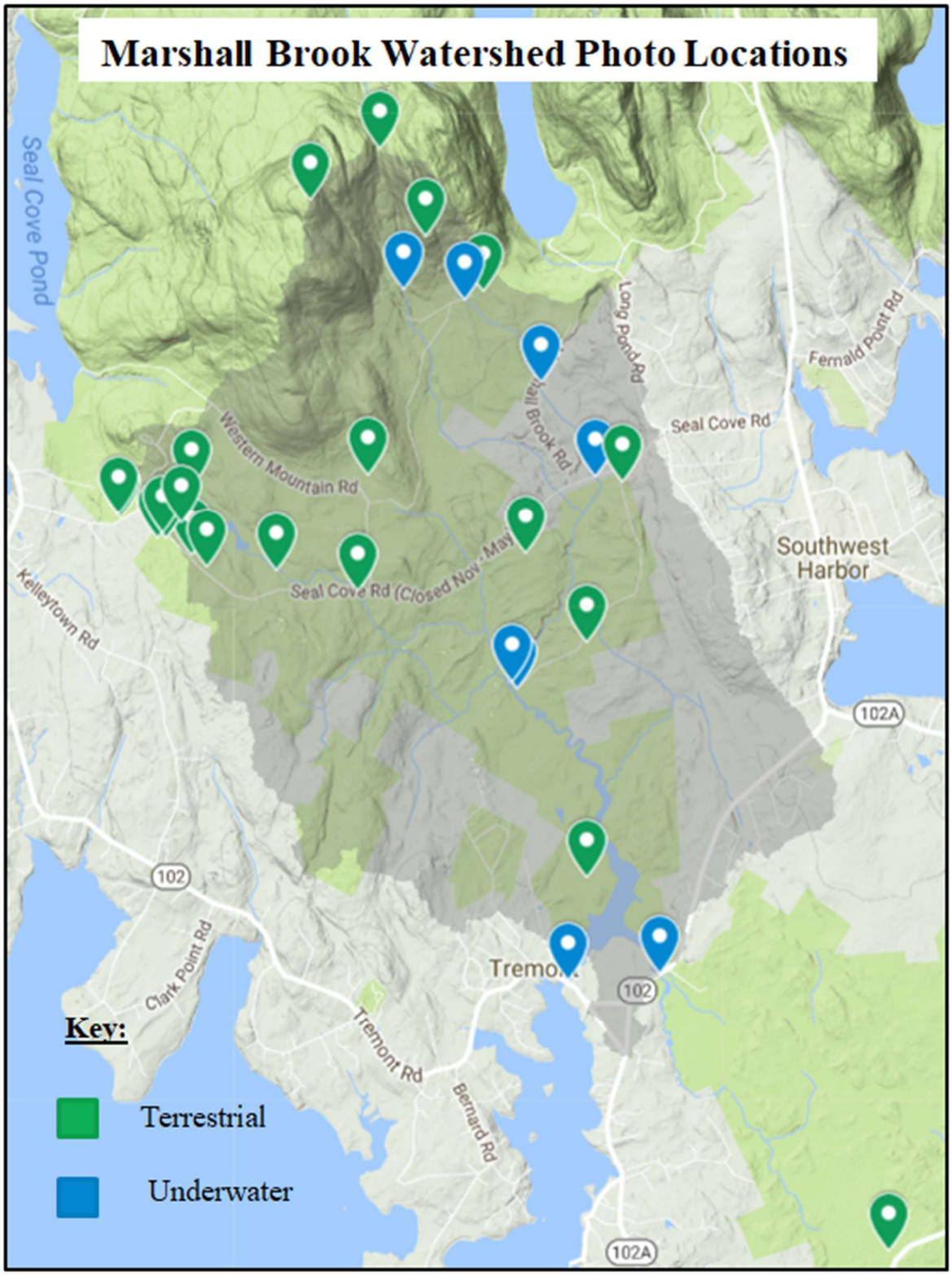
A1 Watershed Diagram



A2 Cromwell Brook Watershed Photo Point Map



A3 Marshall Brook Watershed Photo Point Map



A4 Original Cromwell Data Table

Date	Time	GPS	Photo Location	Photo Filename	Type	Compass Azimuth	Tripod Height (in)
6/16/15	1:45	44 21' 46.0" N 68 12' 21.0" W	2	P1000044.JPG	Single	110	41.9
6/16/15	1:52	44 21' 46.0" N 68 12' 21.0" W	2	P1000045.JPG	Panoramic	55-200	41.9

Lead Leg (in)	Back Legs (in)	Zoom (mm)	Weather	Description
N/A	N/A	25	Light rain, medium fog	between service road and cromwell brook, near beaver lodge
N/A	N/A	25	Light rain, medium fog	between service road and cromwell brook, near beaver lodge

A5 Cromwell Photo Point Master List

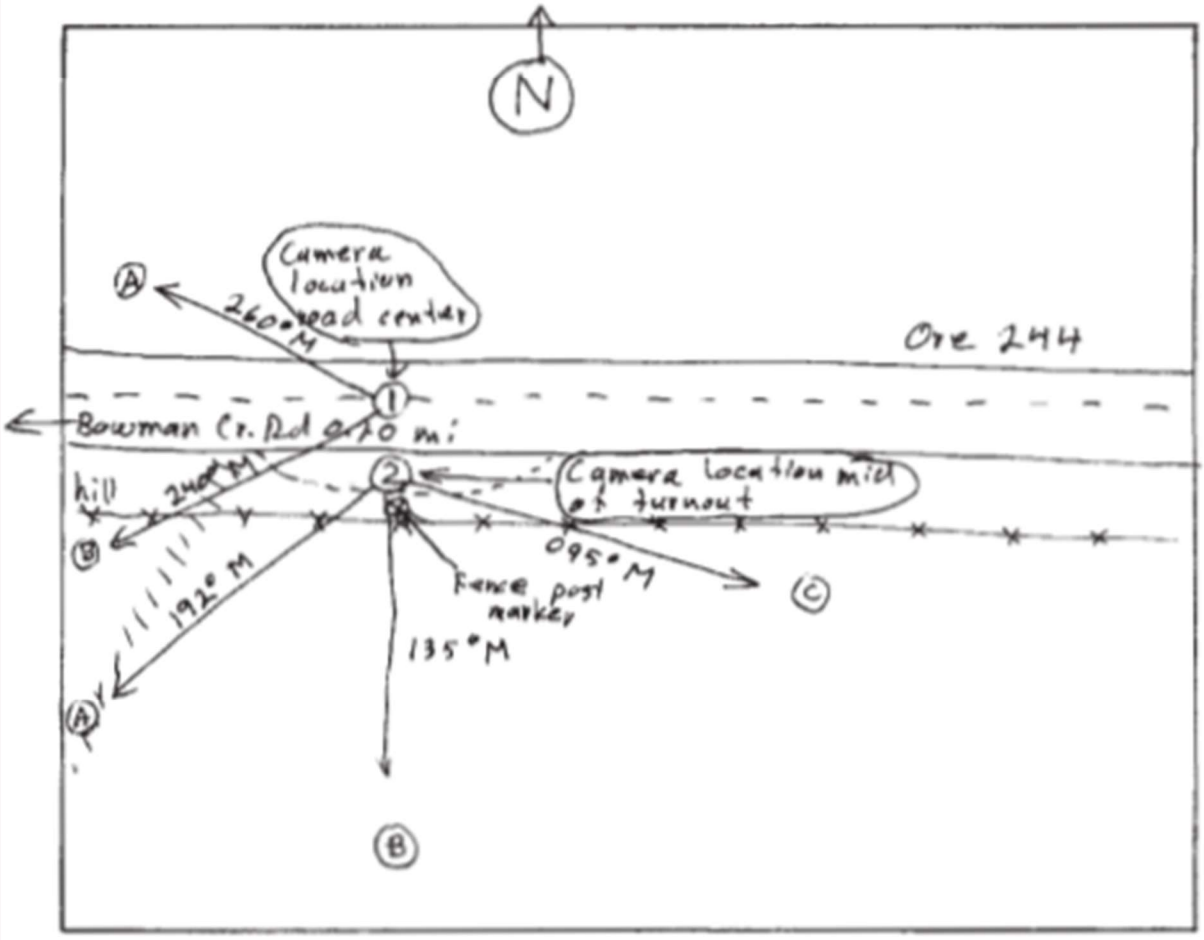
Photopoint	Status	Notes	Complete	Uncertain
1 (In The Tarn)	Complete		38	2
1 (Near Route 3)	Don't worry	Invasive species team took care of this		
1 (Near Town Tennis Courts)	Complete		**Not Done**	**Don't Worry**
1 (Near Jesup Path)	Don't worry	Invasive species team took care of this	2	8
1 (Immediately South of The Tarn)	Don't worry	Invasive species team took care of this		
1 (Wicked South of The Tarn)	Don't worry	Invasive species team took care of this	Updated for 7/6	
1 (Middle of the Great Meadow)	Don't worry	Invasive species team took care of this		
1 (Near Point 2 in Great Meadow, 10)	Don't worry	Invasive species team took care of this		
1 (Near 15 in Great Meadow Loop Trail)	Don't worry	Invasive species team took care of this		
2 (In Great Meadow, Near Park Loop Road)	Complete			
2 (Near Sieur De Monts)	Complete			
2 (North of Point 32)	Complete			
2 (South of Point 32)	Complete			
3	Complete			
4 (Near Golf Course Gravel Storage)	Complete			
4 (North of Point 6)	Complete			
6	Complete			
10	Complete			
12	Complete			
13	Uncertain	Hydrology, needs clarification		
14	Complete			
15 (Near Point 14)	Complete			
15 (Great Meadow Loop Trail)	Complete			
17	Complete			
18	Complete			

A6 Photograph Site Form

PHOTOGRAPHIC SITE DESCRIPTION AND LOCATION

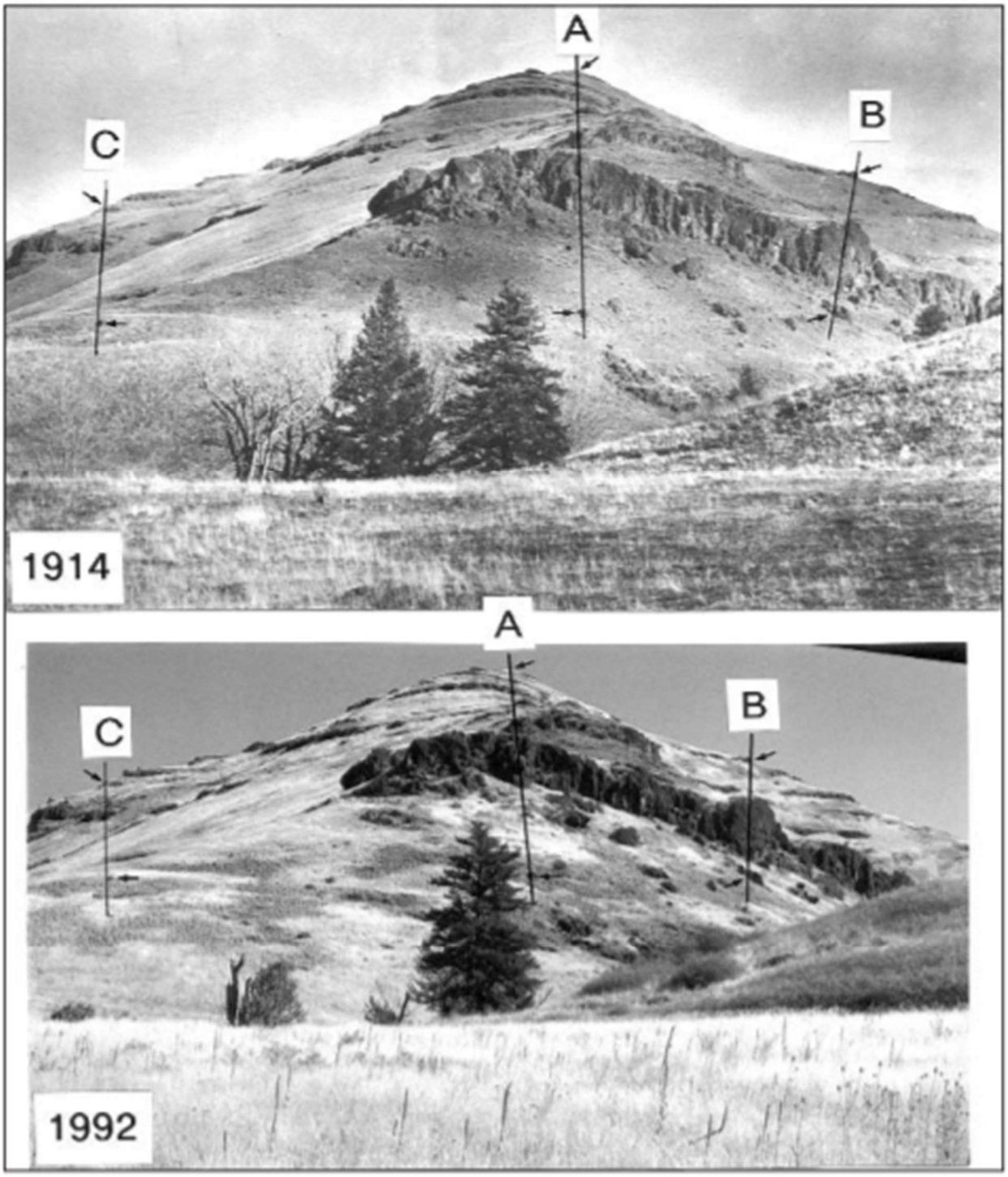
Date Aug 1976 Area Camas Cr. Meadows
Unit Ukiah District Observer: E.C. Hall
Number of photo points 5 Plant community: lodgepole pine
Location: T. 45 R 33E Sec. 35 SW of SW
Location description On Ore. hiway 244 between mile posts 15 & 16; 0.20 mi. east of junc. with Bowman Cr. Rd.
Photo purpose: Document effects of Mt. pine beetle attack on bottomland climax lodgepole pine
Discussion Some beetles noticed in 1975; this year major kill (70%) of dominant lodgepole-needles red. Follow for each year for 3 yrs, then about 5 yr. intervals.

MAP



Use back of sheet for additional details.

A7 Labeled Photograph Accompanying Photo Site Form



A8 Canon 6D Camera

A9 Panasonic Lumix FZ-1000

A10 GoPro Hero 4 camera

A11 GoPro Underwater Light

A12 Garmin E-Trex H GPS

A13 MeFoto A1350 Aluminum tripod

A14 Compass and Measuring Tape

A15 Repeat Photography Field Guide

1. **Photopoint #**

2. **Date**

Example: December 15, 2012

3. **Time (Military Time)**

Example: 8:30 AM

4. **Location**

5. **Environment Description**
Surrounding area including terrain, plant life or other descriptor

6. **Landmarks**
Significant or defining features that could be used to precisely locate photo set up site

7. **Tripod Height**
Vertical distance from ground to center of camera lens

8. **Weather Conditions**

9. **GPS Accuracy**

10. **Latitude (Degrees°Minutes'Seconds"N)**

11. **Longitude (Degrees°Minutes'Seconds"W)**

12. **Bearing (X° E of N) From True North**
Find Magnetic North and subtract current declination

13. **Angle of Camera to stand**
90° means camera is perpendicular to stand

14. **Elevation**

15. **Closest Tidal Event time**
Time of the closest high or low tide if applicable

Example: 8:30 AM

16. **Panorama**
Check all that apply.

- [ ] Yes
- [ ] No

17. **Lens (mm)**

18. **Shutter Speed**

19. **ISO**

20. **Aperture**

21. **Everything in Focus**
Mark only one oval.

- ◯ Yes
- ◯ No

A16 Rite in the Rain Notebooks

Repeat Photography Field Guide

Before you go:

1. Print out all possible set up photos, repeat photos and any applicable data or photos related to the specific photo location you're going to.
2. Analyze photos for specific landmarks that may still be visible i.e. man-made structures, large rocks or bodies of water.
3. Check your equipment to make sure it is both charged and similar to that used by the previous photographer.
4. Identify sites on a map and create a route to travel to each specific photopoint.

In the Field:

1. Using a map and gps, navigate to area of the photo your going to repeat.
2. Once at the photopoint, use the set up photos and repeat photo to determine what was photographed and where the tripod was located.
3. Set the tripod up at the point determined in previous step and use data such as tripod height and compass bearing to align camera in general direction.
4. Identify distinctive features around the edge of the photograph to be repeated and their relative distance to both each other and the edge of the photo.
5. Look through the camera lens to look for these features such as a split tree, boulder, rock formation, stream or embankment in their current state and attempt to locate them a similar distance to the edge of the camera's view.
6. When you are satisfied and believe that you have accurately recreated the photo to the best of your abilities, zoom out slightly if possible and take the picture.
7. Record all extraneous details and data and record set up photographs for the next photographer.

Back at Base:

1. Backup all photos and record and organize all the data, setup photos and old photos as necessary.
2. Compare the initial and repeat photos for accuracy as well as change.
3. If photos are not accurate enough, take note of differences and return to field and try again.

Appendix B: Complete Data Log of All Marshall Brook Photo Points

photo-point number	Date	Location	Description of Environment	Military Time
1	6/25/2018	Adam's Bridge With Views Into Bass Harbor Marsh (Side 1)	-Grassy Marsh -Tidal Marsh area	10:49
2	6/25/2018	Adam's Bridge With Views Into Bass Harbor Marsh (Side 2)	-tidal grassy marsh	10:53
3	6/25/2018	Bridge Impact on Tidal Marsh (Side 1)	-Rocky Bank	11:04
4	6/25/2018	Bridge Impact on Tidal Marsh (Side 2)	-tidal rocky marsh	11:07
5	6/25/2018	Adam's Bridge With Views Into Bass Harbor Marsh (Side 1)	-tidal grassy marsh	16:29
6	6/25/2018	Adam's Bridge With Views Into Bass Harbor Marsh (Side 2)	-Tidal Grassy marsh	16:35
7	6/25/2018	Bridge Impact on Tidal Marsh (Side 1)	Rock Bank	16:46
8	6/25/2018	Bridge Impact on Tidal Marsh (Side 2)	Rocky, tidal Marsh	16:52
9	6/26/2018	Degraded Wetland Condition Due to Road Crossing and Adjace	- Marshy (feet will sink)	11:01
10	6/26/2018	Degraded Wetland Condition Due to Road Crossing and Adjace	-marshy (feet sinking)	11:10
11	6/26/2018	High Quality Wetlands at Improved Road Crossing (Side 1)	-Marshy with a lot of trees -lily pads	11:25
12	6/26/2018	High Quality Wetlands at Improved Road Crossing (Side 2)	-stream	11:29
13	6/26/2018	Lower End of Wetland	(going to be hard to repeat) -mossy lots of tree cover	11:49
14	6/26/2018	Upper End of Wetland	-marshy (difficult to recreate)	12:13
15	6/27/2018	Big Heath Wetland	red, green, and brown vegetation and pla	11:43
16	6/27/2018	Cultural remnants of salt marsh farming	-low grass marsh	12:20
17	6/27/2018	Kelly Cemetery	-graveyard	12:45
18	6/29/2018	Very old cedar swamp (Trees aged at 200 years)	-lots of mossy ground -fallen trees -lots of ferns	11:19
19	6/29/2018	Cultural resource	-wooded lots of fallen trees	11:41
20	6/29/2018	CCC Constructed reservoir	-pond feeding into a reservoir	11:55
21	6/29/2018	CCC Constructed reservoir	- downstream part of the reservoir	11:59
22	6/30/2018	Razorback Overlook	-rocky steep part of the razorback	12:03
23	6/30/2018	Ridge of Razorback mountain	-rocky cliff	12:52
24	6/30/2018	Watershed Divide	woody stream just off the great notch trai	12:50
25	6/30/2018	Overlook along trail	rocky overlook	13:45
26	7/11/2018	Upper end of Bass Harbor Marsh and Limit of tidal influence	-end of fire road (need a key to access)	10:22
27	7/11/2018	Blacksmith Building (Standing)	of a locked road (about a 1/4 of a mile do	9:52
28	7/11/2018	Clear Cut East of Trail	-Break in treeline on the left - off of fire road	10:11
29	7/11/2018	Marshall Brook Tributary	-creek off of fire road	10:34
30	7/11/2018	Looter's Hole	are hole in ground with lilac bushes up fi	10:40
31	7/11/2018	Upper end of Bass Harbor Marsh and Limit of tidal influence	-end the fire road	15:41
32	7/17/2018	Marshall Brook- Marshall Brook Rd Crossing	-creek on the side of the road	11:38
33	7/17/2018	Marshall Brook- Mill Road Crossing	Wooded creek near near gilly field	11:49
34	7/13/2018	Unknown Huge round depression	big round pit	12:11
35	7/13/2018	Well 1	large pit	12:36
36	7/13/2018	Dump 1	oded area with rusted metal pieces and tra	12:02
37	7/13/2018	Mary Nurwoods Grave	Hill with a headstone and footstone	12:37
38	7/13/2018	House Cellar	square hole in the ground	13:11
39	7/13/2018	Dump 2	ash heap near the house cellar photo poir	13:13
40	7/13/2018	Cellar 1	-Cleared area -lots of grass	11:02
41	7/12/2018	CCC Constructed Reservoir (Underwater)	Large reservoir	12:42
42	7/12/2018	High Quality Wetlands at Improved Road Crossing (Underwater	Marsh with a lot of trees	13:02
43	7/12/2018	Degraded Wetland Condition Due to Road Crossing and Adjace	Marshy	13:10
44	7/12/2018	Bridge Impact on Tidal Marsh (Underwater)	Rocky Marsh	13:23
45	7/17/2018	Marshall Brook- Pre-China Hill (Underwater)	at the end of the locked fire road	11:06
46	7/17/2018	Upper End of Bass Harbor Marsh and Limit of Tidal Influence (	End of fire road	10:58
47	7/17/2018	Marshall Brook- Marshall Brook Rd Crossing (Underwater)	Wooded stream just of the road	11:15
48	7/17/2018	Marshall Brook- Mill Road Crossing (Underwater)	Wooded dried up stream	11:49
49	7/12/2018	Adam's Bridge With Views Into Bass Harbor Marsh (Underwate	tidal Marsh	13:35

Landmark	Tripod (in)	Weather Conditions	GPS Accuracy	Latitude
-Orangey rock jetting out (camera on the rock) - right below the bass harbor cottages sign	51 1/2	Overcast and Just rained	10 ft	44°15'20.8" N
-marshy flat (see setup photo)	51 1/2	overcast just rained	10 ft	44°15'19.5" N
circle of rocks (See setup pic)	53 1/2	Overcast with some sun / just rained	10 ft	44° 15' 16.6" N
Level rock point slightly depressed (see set up picture)	53 1/2	Overcast with some sun / Just rained	10 ft	44° 15' 18.6" N
-orangey rock jetting out (camera on rock) -below bass harbor cottages sign	51 1/2	sunny with clouds and rained earlier	26 ft	44°15'20.6" N
-flat mash (see setup photo)	51 1/2	sunny clouds rained earlier	11 ft	44° 15' 19.7" N
circle of rocks (see set up pics)	53.5	Sunny with clouds, rained earlier	11 ft	44 15' 16.8"N
Rocky, level point, slight depresion	53.5	Sunny with cloud cover, rained earlier	15 ft	44 15' 18.7"N
(see set up photo)	61 1/2	Sunny w/t clouds	10 ft	44° 17' 12.5" N
-about 9 feet from side rail on side of road	55	sunny with clouds	10 ft	44° 16' 10.6" N
-Rock cracked in half about 6 ft in front camera	52 1/2	Sunny with clouds	10 ft	40° 16' 67.5" N
-big rock in front of camera with depression on top	52	sunny with clouds	20 ft	44° 16' 65.9" N
-in front of 4 grouped dead trees	52	sunny with clouds	10 ft	44° 16' 72.3" N
-big open marsh	45	Sunny with clouds	13 ft	44° 17' 7.4" N
three man made poles (green, rusted and pvc painted camoufla	52	partly cloudly	14 ft	44°14' 17.0" N
wood post	51	partly cloudy	14 ft	44° 15' 52.8"
three big posts to the end of fence	64 1/2	partly cloudy	13 ft	44° 16' 80.5" N
See set up photos	52 in	Sunny with clouds	19 ft	44° 17' 10.7" N
-big rooded up tree and baby pine trees -see setup photo	51	Sunny with clouds	19 ft	44° 17' 85.9" N
-end of concrete strip closet to stone steps	55 in	sunny w/t clouds	10 ft	44° 17' 82.0" N
he other side of the downstream part of the reservoir on flat gr	55	sunny w/t clouds	10 ft	44° 17' 81.0" N
-on blue mark on cliff	55 1/2	sunny & clear	10 ft	44° 18' 1.1" N
-lots of blue marks on ridge - just past the junction sign	52	sunny and clear	11 ft	44° 18' 33.2" N
-200 feet from cross way junction -right off of the great notch trail	54	sunny and clear	10 ft	44° 18' 36.4" N
-Bernard overlook -left most wooden bench	64 1/2	sunny and clear	10 ft	44° 18' 19.1' N
-end of trail -to the left of rock step	54	cloudy and overcast	10 ft	44° 16' 29.4" N
-about centered 50 ft in front of the structure -see setup pick	35	sunny with clouds	10 ft	44° 16' 81.7" N
-tree stump	51 in	cloudy	14 ft	44°16' 44.4" N
-about 50 ft from road	50	partly cloudy	15 ft	44° 17' 05.5" N
-dead low brush -lilacs in the back	53	cloudy	10 ft	44° 16' 89.9" N
-end of fire road trail -to the left of rock step	54	sunny and clear	10 ft	44° 16' 28.9" N
-about 100 ft from the road on the right	53	cloudy	18 ft	44° 17' 47.1" N
next to big tree and fallen debris	54 in	cloudy	13 ft	44° 17' 78.9" N
10 ft in front of hole	53	clear and sunny	10 ft	44° 26' 87.7" N
stone circle with depression	freehand	sunny	N/A	44° 16' 81.0" N
Straight back from Seal Cove Road	52in	Sunny and Clear	10 ft	44° 16' 87.4" N
Grave	52	Sunny and Clear	14 ft	44° 16' 92.6" N
Clearing through trees and bushes	52	Sunny and Clear	20 ft	44° 16' 94.8" N
Big orange pole	52	Clear and Sunny	17 ft	44° 16' 95.0" N
-two huge pine trees -deep pit	51 1/2	Sunny and Clear	11 ft	44° 16' 76.5" N
Taken at front of the reservoir and at the wall of the reservoir	N/A	Sunny and Clear	N/A	44° 17' 51.0" N
Taken on both sides	N/A	Sunny and Clear	N/A	44° 16' 67.5" N
Right in front of under bridge opening	N/A	N/A	N/A	44° 17' 12.5" N
taken on both sides of the bridge (in front of the bridge)	N/A	Sunny and Clear	N/A	44° 15' 16.6" N
Beaver Dam	N/A	N/A	N/A	44° 16' 31.8" N
taken close to the stairs into the stream	N/A	Cloudy	N/A	44° 16' 29.2" N
Near two metal poles	N/A	Cloudy	N/A	44° 17' 47.1" N
N/A	N/A	Cloudy	N/A	44° 17' 87.3" N
In front of the culvert	N/A	Sunny and Clear	N/A	44° 15' 12.4" N

Longitude	Bearing	Angle to stand	Elevation	Tide?	Panorama?	Lens (mm)	Sutter Speed	ISO	Appeture
68°20'47.4" W	88° E of N	90	11ft	High @ 09:47	no	50	640	640	10
68°20'42.7" W	294° E of N	90	19ft	High @ 09:47	no	50	640	640	10
68° 20' 97.0" W	74° E of N	90	9ft	High @ 09:47	no	50	640	640	10
68° 20' 91.7 W	258° E of N	90°	17ft	High @ 09:47	yes	50	640	640	10
68° 20' 47.5"	88° E of N	90°	22 ft	Low @ 15:50	yes	50	640	500	10
68° 20' 42.7" W	294° E of N	90°	19ft	Low @ 15:50	yes	50	640	500	10
68 20' 97.7"W	74 E of N	90	27ft	Low @ 15:50	yes	50	640	500	10
68 20' 91.7"W	258 E of N	90	17ft	Low @ 15:50	yes	50	640	500	10
68° 20' 76.9" W	152° E of N	90°	63 ft	N/A	yes	50	640	500	10
68° 20' 77.3" W	96° E of N	80°	58ft	N/A	yes	50	640	500	10
68° 22' 9.0" W	200° E of N	90°	11 ft	N/A	yes	50	250	500	10
68° 22' 7.8 W	320° E of N	90	100 ft	N/A	yes	50	100	500	10
68° 22' 47.8" W	100° E of N	90°	150 ft	N/A	yes	50	320	500	10
68° 23' 5.2" W	266° E of N	90°	131 ft	N/A	yes	50	320	500	10
68° 19' 22.6" W	238° E of N	90°	48 ft	N/A	yes	50	800	500	10
68° 20' 92.3" W	38° E of N	90°	24 ft	N/A	yes	50	800	500	10
68° 22' 98.4" W	60° E of N	90°	222 ft	N/A	yes	50	800	500	10
68° 22' 4.1" W	22° E of N	90	22 ft	N/A	yes	50	400	500	10
68° 21' 41.2" W	158° E of N	90	250 ft	N/A	yes	50	400	500	10
68° 21' 80.9" W	330° E of N	78°	208 ft	N/A	yes	50	400	500	10
68° 21' 81.9" W	350° E of N	90	230 ft	N/A	yes	50	400	500	10
68° 21' 70.7 W	158° E of N	90°	562 ft	N/A	yes	50	500	320	10
68° 21' 84.2" W	324° E of N	90°	830 ft	N/A		50	500	32	10
68° 21' 96.4" W	176° E of N	90°	770 ft	N/A	yes	50	50	100	10
68° 22' 34.8" W	298° E of N	90°	1064ft	N/A	yes	50	500	400	10
68° 21' 22.5" W	224° E of N	90	46ft	High @ 09:38	yes	50	200	800	10
68° 21' 16.8" W	204° E of N	90	96	N/A	yes	50	200	800	10
68° 20' 82.3" W	98° E of N	90°	71	N/A	yes	50	400	800	10
68° 20' 39.0" W	100° E of N	90°	112	N/A	yes	50	160	1600	10
68° 23' 13.5" W	70 E of N	90°	234°	N/A	yes	50	160	810	10
68° 21' 22.6" W	224° E of N	90°	46ft	N/A	yes	50	150	300	10
68° 21' 08.6" W	4° E of N	45°	73 ft	N/A	yes	50	200	1000	8
68° 21' 46.9" W	105° E of N	90	178 ft	N/A	yes	50	200	1000	8
68° 23' 11.3" W	N/A	75°	215ft	N/A	yes	50	200	1200	9
68° 23' 11.0" W	right above	right above	227 ft	N/A	regular photo	N/A	N/A	N/A	N/A
68° 23' 15.9" W	244° E of N	45°	223 ft	N/A	yes	50	200	1200	9
68° 23' 03.1" W	250° E of N	85°	205 ft	N/A	no	50	200	1200	9
68° 23' 35.9" W	284° E of N	90°	221 Ft	N/A	yes	50	200	1200	9
68° 23' 36.6" W	N/A	90	205	N/A	yes	50	200	1200	9
68° 22' 87.7" W	124° E of N	90°	185 ft	N/A	yes	50	100	1000	8
68° 21' 50.0" W	N/A	N/A	190 ft	N/A	N/A	N/A	N/A	N/A	N/A
68° 22' 09.0" W	N/A	N/A	11	N/A	N/A	N/A	N/A	N/A	N/A
68° 20' 76.9" W	N/A	N/A	63ft	N/A	N/A	N/A	N/A	N/A	N/A
68° 20' 97.9" W	N/A	N/A	9ft	N/A	N/A	N/A	N/A	N/A	N/A
68° 21' 24.0" W	N/A	N/A	30 ft	N/A	N/A	N/A	N/A	N/A	N/A
68° 21' 22.7" W	N/A	N/A	131	N/A	N/A	N/A	N/A	N/A	N/A
68° 21' 08.6" W	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
68° 21' 37.6" W	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
68° 220' 26.5" W	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Everything in Focus
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